Art. IV.—*The Geology of the Lower Leigh Valley.*

By JOHN DENNANT, F.G.S., F.C.S.,

AND

J. F. MULDER.

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(With Plates V. and VI.).

The River Leigh, or Yarrowee as it is sometimes called, rises in the Dividing Range, and after a generally south course empties itself into the Barwon River at Inverleigh. Though only a moderate-sized stream, it has for many miles of its course cut a wide and deep gorge in the face of the country. In places, extensive flats are enclosed between the opposite banks, as, for example, that on which the small township of Shelford stands, and another near Dog Island, higher up the river.

We shall confine our description of the geological features of the gorge to the lower part of the river, namely, from Reid's Creek on the north to Inverleigh on the south. The country intersected by the river from Dog Island northwards to a point a little west of McQuinn's Creek was geologically surveyed, mapped, and reported upon by Messrs. Etheridge and Murray in 1867-8.[1] A small portion of the mapped area, viz., from Dog Island to Reid's Creek is remarked upon by us, as it includes an important eocene section. The actual boundary of the eocene is some distance beyond, but as, judging from the Survey's report, the few remaining outcrops are comparatively uninteresting, we did not visit them. Previous notices of the unmapped area to the south are, we believe, confined to two papers by ourselves, one on eocene and the other on miocene rocks in the vicinity of Shelford.[2] In the first of these a list of the fossil contents of the Red Bluff section was included, but the number of species known from that bed has since been much

1 Quarter-sheet 26 S.E. and Progress Report, No. II.

2 Geelong Naturalist, Sept., 1894; Trans. R. S. Vic., 1897.

increased. From the escarpments higher up the river many additional forms have also been collected. Moreover, some important revision work has been lately done by various palæoconchologists, and a greatly extended, as well as revised, list of fossils is herein submitted.

Eocene Beds.

In discussing these, it will be most convenient to commence with that at the Red Bluff (Sec. II.), which is the best known and by far the richest of the fossiliferous outcrops on the river. As stated in our previous notice of it, the fossils on the exposed face adjoining the river show only for about 50 feet from the water's edge, but a rubbly decomposed limestone can be traced to a farther height of 100 feet; that is, within 40 feet of the level country at the top. On the northern face of the bluff the limestone is occasionally hard and compact, but fossils in it are exceedingly scarce. Much of the hill is masked by ironstone and basaltic boulders fallen from above—so much so, indeed, that on a cursory inspection one is apt to regard the basalt as a much thicker deposit than it really is. Above the limestone, at the spot where the section was measured, there is about 15 feet of ironstone conglomerate (miocene), which passes directly under the capping of basalt on the summit. The section is therefore—

Basalt		25 feet
Miocene conglomerate		15 ,,
Eocene	Rubbly limestone	100 ,,
	Fossiliferous clays	50 ,,
Total ...		190 feet

Erosion of the eocene surface prior to the deposition of the miocene is evident enough, not only here, but in other sections to be quoted, and the younger rock has apparently filled in depressions in the older; thus, a few yards to the west of the measured section, miocene boulders were seen cropping out from ten to fifteen feet lower down the hill. On the other hand, where the junction of the miocene with the basalt is visible on the bluff, the latter rock rests horizontally upon the levelled off surface of the former.

On the opposite side of the river, and about two miles below the Red Bluff, there is an eocene outcrop, which we examined (Sec. I.). Here the fossils, which resemble those at Section II., are sparingly distributed in a clayey matrix. They cease at a height of 80 feet from the river, and are then succeeded by clays and sandy ironstone, mingled with quartz pebbles. No fossils were observed in the ironstone, but we have no hesitation in classing it as miocene. There is no capping of basalt above it, as this rock is absent from the east bank of the river from Golf Hill right on to Inverleigh. Amongst the fossiliferous clays of this section there is in places a deposit of powdery, cream-white carbonate of lime, which, if continuous down to any depth, might prove of commercial value.

We did not examine the eastern bank of the Leigh between here and Inverleigh, but at the latter place we observed a long stretch of eocene clays just above the water's edge, and the continuance of eocene strata all the way is therefore assumed. As we drove along the western bank from Inverleigh to the Red Bluff, several outcrops of limestone were noticed; and in one place, where a dam had been excavated, the same rock, much decomposed, showed below the alluvium of the flat. Eocene limestone also crops out occasionally, both at the level of the road and at a considerable elevation on the bank between the Red Bluff and Shelford. There is, however, no more clay, and though fossils are certainly obtainable by patient searching, they can rarely be extracted whole. The relations of these limestones to the accompanying basalt and overlying miocenes are very interesting; but their discussion must be postponed till the remaining eocene sections have been described.

The next notable outcrop is just over the Shelford Bridge, on the east side of the river (Sec. V.), where the incline leading to the table-land on the summit of the bank has been cut down in making the road, and the steep face thus formed has exposed the eocene strata for a distance of about 100 yards. They consist of calcareous clays, with thin bands of limestone running through them. Observations of the dip of these bands were made, with the following results. At the first station, close to the commencement of the cutting, an apparent dip of 4° to east 5° north, was recorded. At the second station, 30 yards up the hill, and

also at the third station, 50 yards higher up still, the bands run horizontally due east and west. There is thus a change of direction in the face of the cutting amounting to about 5° between the first and the succeeding stations. At the same time the dip changes abruptly from 4° to 0°. Either there is current bedding for a short distance, or, as is more likely, by a slight change in the direction of the cutting at the first station, the true dip from the hill, *i.e.*, towards the north, is indicated. The rocks are too rough and crumbly to admit of very exact measurements.

Fossils are not only very scarce in the section, but they are also so rotten, that in an hour's search only a few fragments were obtained. Amongst them we recognised the following :—

Dimya dissimilis	Cidaris spp. (spines)
Ostrea hyotis	Cellepora fossa
Terebratula sp.	Lunulites rutella

and other species of polyzoa.

The organisms were traced up to an elevation of 150 feet above the water's edge, but unfossiliferous limestone was found for 30 feet higher. Above the limestone, ironstone boulders occur and continue to the hill-top. These again we class as miocene.

It may be conveniently mentioned here that the river level at Shelford Bridge is the datum line, to which reference is occasionally made in this paper. Its height above sea level is not precisely known, but from aneroid readings, with Leigh Road Railway Station for the starting point, we estimate it as between 220 and 250 feet.

In following up the river from the bridge through Golf Hill pre-emptive block, the eocene is practically concealed beneath later deposits, but that it is still present is proved by the nodules of limestone thrown out of rabbit burrows, or from holes dug by the station people. Higher up, the banks are steeper than in the neighbourhood of Golf Hill, and several fine sections of the eocene are exposed. The most prominent of them is on the eastern bank, immediately south of a small island, locally known as Bull Island, which is formed by a short billabong in the course of the river. Perhaps the prettiest scenery in the Lower Leigh Valley is to be found here. The fossil banks form an amphi-

theatre surrounding an extensive flat, through which the stream pursues a very tortuous course. Close at hand is the basalt capped hill called Dog Island, while in the distance the narrow gorge of the Dog Rocks bounds the view. The name Dog Island, commonly applied to the hill just mentioned, is quite inappropriate, as it is not really an island at all, the river flowing on its west and south sides only; on the north and east, the land, though slightly depressed, is still much above the river, which, we are assured, never inundates it, even in the highest floods.

Further remarks to be made upon the rocks of Dog Island are postponed till the principal eocene sections in the vicinity have been described.

At the Amphitheatre or Bull Island section (No. X.), the strata exposed on the bank are:—

Ironstone drift	40 feet
Limestone, masked by reddish clay ...	50 ,,
Banded limestone, with eocene fossils ...	40 ,,
Marls, yielding an abundance of fossils, with blocks of hard limestone	90 ,,
River alluvium	20 ,,
Total height of bank ...	240 feet

In the marls are disseminated small quartz pebbles, while fragments of ironstone, no doubt derived from above, occur on their surface.

The water level at the foot of the bank is 80 feet above our datum line, and the upper bands of limestone here thus reach a greater elevation than similar rocks at the top of the eocene in the Shelford Bridge and Red Bluff sections. So also the gastropod bed at the base of the Red Bluff is lower than the marls of Bull Island. It is probable that these marls do not extend far below the surface, as silurian rocks crop out in the river bed a few chains to the north.

Nearly all the fossils quoted in our list were obtained from the amphitheatre and Red Bluff sections, which may be taken as respectively typical of the deposits to the north and south of Shelford. It is apparent that, though largely similar in both,

they are not entirely so. Being a previously unexplored bed, the majority of the new species recorded are, as might be expected, from the amphitheatre marls; in addition, these yield some which, so far, have not occurred in our gatherings at the Bluff, though they are known from more distant eocene deposits, as Belmont, Curlewis, Birregurra, Spring Creek, etc. We have thought it advisable to indicate the species which are special to either of the two sets of beds mentioned. This information is supplied more for the sake of future reference than for any immediate use we propose to make of it.

On the Bull Island section the fossils occur either loose on the surface or slightly adherent to the marly matrix. Many of the smaller species were obtained by sifting and washing the finer and more calcareous material.

Speaking of this and similar beds near at hand, Mr. Wilkinson, who surveyed the area many years ago, says: "These clays abound in well-preserved fossils. The surface of the out-cropping beds often glitters with the white shells which have been exposed by atmospheric action." When first seen by us this description was still correct. Fossils have now, however, become very scarce; and since none can be got by digging, future collectors must wait for a fresh crop to weather out.

There are occasional bands of limestone in the marls themselves, but above them the strata are composed of the former rock only, arranged in a series of horizontal shelves, which show for a long distance on the river banks. The limestone is a hard, solid rock, and contains very few recognisable fossils, but these few are also common in the clays. It took an hour's searching to obtain the following:—

Ostrea hyotis?	Lovenia forbesii
Waldheimia garibaldiana	Lepralia edax
Waldheimia sp.	Salenaria sp.

and some indeterminable fragments.

Though the marls and limestones are lithologically so different, we yet regard them as palæontologically inseparable. We are led to take this view, not so much from a comparison of the few fossils collected in the upper strata with the rich fauna of the lower as from observations made at the next section (No. IX.), about a mile down the river and close to the southern boundary

of Henderson's Flat. Horizontal bands of limestone were noticed, as we crossed this flat, high up on the bank, and it was at first taken for granted that they continued up to the ironstone covering; but a closer examination showed that above these were clays, with well-preserved molluscan and coral forms similar to those at the amphitheatre. Fossils were gathered up to a height of 150 feet above the river, and the clay deposit is thus about on a level with the upper limestones, or 40 feet higher than the marls in Sec. X. There are about 20 feet of clays, and below them succeed limestones almost to the level of the alluvial flat. Change in the sediments, or, more probably, infiltration and subsequent consolidation of the material, may account for the limestone bands amongst the fossiliferous marls and clays of these sections.

Allusion has been made to the horizontal disposition of the strata at one or two sections. This is very clearly seen on the banks of Henderson's Flat at Sec. IX., and thence on to a little beyond Sec. X. In the latter locality, the amphitheatre encloses an angle of about 100 degrees, and on both of its sides the limestone bands, as tested by the clinometer, appeared horizontal; the observations were made on the summit of Dog Island, from which a good view of the amphitheatre is obtained.

At the two outcrops last described basaltic rocks are entirely wanting. It is important to note this, because just below Henderson's Flat, and thus quite close at hand, there is, at a comparatively low level on both sides of the river banks, a fringe of basalt, which has passed over eocene strata in two small exposures, one on the east and the other on the west side of the stream. This flow can be traced for some miles, and is quite distinct from the elevated and more extensive one which covers the table-land on the summit of the western bank. The lower and much older flow, for such it really is, shows only for a short distance on the eastern margin of the river, and thus, we think, never invaded the marls and limestones of Sections IX. and X.

This interesting lower flow will be discussed more fully later on; just now the sediments covered by it in the two sections mentioned are briefly noted.

In that on the eastern bank (Sec. VIII.), where the gorge of the river narrows at the termination of Henderson's Flat, a

massive limestone crops out about 12 feet from the water's edge. Both above and below there is clayey material containing the usual fossils. In the limestone itself the fossils are scarce, but they include only forms common to the clays. At a height of 100 feet the eocene is overlain by the lower basalt, which continues for the next 30 feet, when ironstone nodules of supposed miocene age succeed. The rocky basaltic promontory close to this outcrop is locally known as Point Henry; it forms really the eastern boundary of the lower flow, since, as we have seen, there is no sign of basalt from the base to the summit of the adjoining section on the east (No. IX.). At Sec. VII., nearly opposite on the western bank, the fossiliferous beds appear at the margin of the stream. Their junction with the overlying basalt is masked by soil, but a few boulders of the latter rock were noticed at a height of 150 feet. Fossils are abundant, though generally very fragile. Still, a few good shells were obtained here, and, by washing the fine calcareous material, many examples of the minuter species were added to our collection. The bed belongs to the type of the marls of the amphitheatre, and contains the same species. A few chains to the south, but about 60 feet up the bank, we observed an outcrop of limestone rocks in a gully running back from the river. Amongst some others, we noticed the following common fossils in this limestone :—

Bullinella aratula	Nuculana vagans
Amussium zitelli	Meretrix eburnea

We traced this gully up almost to the basalt-covered tableland at the summit of the bank, and noted the following outcropping strata :—

Newer basalt	40 feet
Ironstone, probably miocene (no fossils observed)	30 ,,
Limestone, with *Cellepora fossa* ...	40 ,,
Lower basalt	50 ,,
Limestone, partly masked by alluvium	100 ,,
Total height of bank	260 feet

We were unable to determine whether the upper layer of limestone actually rested on the lower basalt; if so, the latter would, of course, be an intercalated flow. Probably, however, it is simply banked up against eocene strata which are connected beneath with the main mass.

There are several other exposures of the eocene on the western bank in the vicinity of the four sections just described, in which, for the most part, the lower basalt is the immediately overlying rock. Just south of Dog Island, however, and on the opposite or western side of the river, a mass of basalt, 25 feet thick and only 35 feet at its base above the water, appeared to us to be banked up against a limestone hill.

The following section across the river from Bull Island, and thus opposite the amphitheatre, was also observed :—

Limestone	10 feet
Lower basalt	50 ,,
Limestone, with fossils	25 ,,
River alluvium	5 ,,
	90 feet

A few yards to the south, however, the lower basalt crops out again at a height of 100 feet. We read this to mean that the basalt flowed *round* a mound of limestone and *over* the main mass.

On the west of the river there are one or two extensive gullies which are worth examination. We had only time to pay a hurried visit to one of them, which, on account of its rugged nature, we call Rocky Gully. This starts exactly opposite Point Henry, and runs in a northerly direction for about a mile and a half, until it terminates at the level of the upper basalt. Near its head, marls and limestones, the former showing the usual fossils, crop out just under the basalt, a thin layer of miocene only intervening. Down the centre of the gully there is a narrow water-way, thickly strewn with a confused mass of basaltic boulders, often of large size, mingled with occasional blocks of limestone. All of these have probably fallen from above, as at the head of the gully only was any basalt *in situ* noticed. We propose to examine this gully more closely on a future occasion.

The remaining eocene sections noted on the accompanying map of the Leigh River are to the north of Dog Island, and in the surveyed area. As pointed out by Mr. Wilkinson, they are of a different character to the beds which have just been described. On proceeding northwards from the amphitheatre, the horizontal bands of limestone, which there stand out so prominently on the face of the escarpment, soon disappear, being afterwards masked either by basalt or a covering of surface soil. From the neighbourhood of Dog Island there is a lava flow at the summit of the eastern as well as of the western bank, and by the Survey these flows are considered to originate from separate vents. At one spot, between Dog Island and the so-called Dog Rocks, there is a bold bluff of basalt, and below it limestone, apparently unfossiliferous, resting upon ordovician slates, which now become a conspicuous feature in the river-bed, and also for some distance up the banks on either side. A section in this neighbourhood is quoted by the Survey as showing the following succession of rocks :—

Vesicular basalt.
Soft yellow coralline limestone.
Thin bedded silurian sandstone.

The section we examined (No. XI.) is at the Dog Rocks, close to a deep pool of water, which bars further progress along the base of the escarpment on the eastern bank. Its position is approximately marked upon the map. The rocks there displayed are :—

Basalt	60 feet
Polyzoal limestone	55 „
Almost vertical ordovician	125 „
Total height of bank	240 feet

Concerning the coralline limestone or, as it is more correctly termed, "polyzoal limestone," near the mouth of Reid's Creek and in a few other places, Mr. Wilkinson says: "These upper beds consist of a soft yellow limestone, composed of an aggregate of fragments of polyzoa, corals, spines of echinoderms, and a few shells, chiefly terebratula, ostrea, pecten, etc. So broken are these fossils that one is rarely found perfect. The limestone is

sometimes very sandy, but generally it is wholly composed of a mixed mass of comminuted fragments of polyzoa."

At the Dog Rocks section the limestone is inaccessible, except at its highest portion, and slopes away from the nearly vertical silurian strata. We examined its contents by means of the blocks which have fallen down from above on to the silurian floor of the river-bed. It is, as Mr. Wilkinson says, crowded with polyzoa, but the determinable molluscan remains are very few, and the rock is so hard that we could only break out fragments of the fossils showing on the surface of the blocks. Amongst them we determined :—

Spondylus pseudoradula	Pecten polymorphoides
Ostrea sp.	Pecten sp.
Pseudamussium hochstetteri ?	Terebratula sp.
Pecten subbifrons	Cidaris sp. (spines)

In the quotation from Mr. Wilkinson just given, he alludes to these limestones as "Upper," and distinguishes them from the clays with gastropods, etc., which he terms "Middle" Miocene (Eocene). Certainly the polyzoal limestone of the Dog Rocks is at a higher level than the clays, etc., of the amphitheatre. According to our measurements, a horizontal line carried from the base of the polyzoal strata in the former section would just cut the top of the horizontal banded limestone in the latter. Apparently the polyzoal strata are also horizontally disposed, but the section is a short one, and a slight dip in some direction may possibly exist. Probably, therefore, in terming such beds the "Upper," and those of the amphitheatre the "Middle," Mr. Wilkinson only intended to convey the idea of superposition for the polyzoal rocks, and not to assert that any marked difference of geological age existed between the two sets of strata. In reference to this question of superposition for the strata under consideration, we simply remark that no actual contact of the polyzoal rock with the marls and limestones of the amphitheatre type was observed by us at any section on the river ; and, in the absence of such contact, we cannot venture to pronounce on the actual sequence of the beds. Palæontologically, we hold them to be inseparable, basing our opinion, as far as the polyzoal rock is concerned, not merely on the few

fossils derived from the Dog Rocks section, but upon experience of similar strata in other localities. According to the Survey, there is an outcrop of the so-called Middle Miocene (Eocene) about two and a half miles farther up the river, but as no fossils are mentioned, we did not consider that there was sufficient encouragement to search for it.

We have now reviewed the principal eocene sections on the Leigh. The number of fossil species collected from them amount to 447, which are tabulated as follows :—

Pisces		1
Mollusca	Gastropoda	316
	Scaphopoda	5
	Lamellibranchiata	82
	Palliobranchiata	6
Echinodermata		4
Actinozoa		33

The Polyzoa and Foraminifera are not included in our enumeration.

The only recent species of Mollusca recognised are :—

Hipponyx antiquatus	Ostrea hyotis
Crepidula unguiformis	Axinæa laticostata
Dentalium lacteum	Limopsis belcheri

Saxicava arctica?

and the proportion of living to extinct forms is therefore 1·7 per cent.

For Muddy Creek and Spring Creek, the distribution is fully given in our list; for other localities only occasionally.

Fossils collected only from sections south of Shelford are denoted by an asterisk, and from those to the north only by a dagger; in a few cases there is some uncertainty concerning this special record, and a query is then prefixed When no sign appears before the name of a fossil it is common to both the north and south sections.

For the identifications of many of the species listed we have consulted Professor Tate, who most willingly placed his wide knowledge of tertiary mollusca at our service.

List of Eocene Fossils.

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Pisces.			
†Lamna sp.			
Gastropoda.			
*Actæon olivellaeformis, Tate	x	x	
*Semiactaeon microplocus, Cossmann	x		Mornington.
Scaphander tenuis, Harris	x		Mornington.
*Scaphander admirandus, Tate *m.s.*			Mornington.
Bullinella aratula, Cossmann	x		Cape Otway.
*Bullinella infundibulata, Cossmann	x	x	
†Bullinella angustata, Tate and Cossmann	x	x	Adelaide.
*Bullinella cuneopsis, Cossmann	x		Bairnsdale.
*Bullinella phanerospira, Cossmann	x		Birregurra.
*Bullinella altiplica, Cossman			Mornington.
? Bullinella sp.			
Ringicula lactea, Johnston	x	x	Table Cape.
Ringicula tenuilirata, Cossmann		x	
†Umbraculum australe, Harris	x		Mornington.
*Terebra platyspira, Tate	x		
*Terebra additoides, T. Woods		x	Table Cape; *Miocene*, Muddy Creek.
Conus ligatus, Tate	x		

LIST OF EOCENE FOSSILS (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
*Conus cuspidatus, Tate	x		
*Conus dennanti, Tate	x	x	
Conus heterospira, Tate	x		
†Conus pullulescens, T. Woods	x	x	
Bathytoma angustifrons, Tate	x		
Bathytoma sp., *aff. B. paracantha*	x	x	
†Surcula sp.		x	
†Surcula sp., *aff. S. johnstoni*			
Surcula sp.	x		Camperdown.
Pleurotoma murndaliana, T. Woods	x		
*Pleurotoma subconcava, Harris			Fyan's Ford.
Pleurotoma clarae, T. Woods	x		Cape Otway.
*Pleurotoma septemlirata, Harris (*Syn. P. trilirata, Harris*)	x	x	
Pleurotoma mulderi, Tate, *m.s.*			Cape Otway; Mornington.
*Pleurotoma, n. sp.			
*Pleurotoma, n. sp.			Curlewis.
*Asthenotoma consutilis, T. Woods	x	x	
*Asthenotoma, n. sp.			
*Asthenotoma, n. sp.			
Cordiera conospira, Tate	x		Table Cape.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
? Borsonia, n. sp.	x		
†Borsonia, n. sp.			
Drillia trevori, T. Woods	x		Mornington
Drillia integra, T. Woods	x	x	
*Drillia vixumbilicata, Harris	x		
Drillia sandleroides, T. Woods		x	Table Cape.
†Drillia, n. sp., *aff. D. trevori*			Moorabool.
*Drillia sp.	x		Gellibrand.
Drillia, n. sp.			Mornington.
*Drillia sp.	x		Mornington.
*Drillia sp.	x		
? Bela pulchra, Tate	x	x	
†Bela, n. sp.			Belmont.
Buchozia hemiothone, T. Woods	x		Curlewis.
†Buchozia cominelloides, Tate, *m.s.*		x	Belmont.
Buchozia sp. 1, *aff. B. cominelloides*	x		Gellibrand.
*Buchozia sp. 2, *aff. B. cominelloides*	x		
Buchozia sp.			Curlewis.
*Daphnobela gracillima, T. Woods	x	x	
†Daphnobela sp., *cf. D. recticostata*			
Clathurella bidens, T. Woods (*Syn. C. obdita, Harris*)	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
*Clathurella, n. sp.			
Clathurella sp.	x		
Clathurella sp.	x		Belmont.
Clathurella sp.	x	x	
*Clathurella sp.			
*Clathurella sp.			
†Clathurella, n. sp.			Curlewis.
*Cythara obsoleta, Harris	x		
Mitromorpha daphnelloides, T. Woods	x	x	
†Mangilia sp.	x		
*Mangilia sp	x		Moorabool.
Mangilia, n. sp.			
Mangilia sp.	x		Mornington.
*Mangilia sp.			Curlewis.
Mangilia sp.			
Cancellaria varicifera, T. Woods	x	x	
Cancellaria epidromiformis, Tate	x		
*Cancellaria platypleura, Tate	x		
*Cancellaria gradata, Tate	x		River Murray.
*Cancellaria exaltata, Tate			Mornington.
*Cancellaria capillata, Tate, *m.s.*	x		Curlewis.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
†Cancellaria, n. sp., *aff. C. wannonensis*			
†Cancellaria, n. sp., *aff. C. continua*			
†Cancellaria, n. sp.			
Olivella adelaidae, Tate	x	x	Adelaide.
Ancilla hebera, Hutton	x	x	
Ancilla pseudaustralis, Tate	x	x	
Ancilla cylindracea, Tate, *m.s.*		x	Table Cape.
†Ancilla orycta? Tate		x	*Miocene*, Gippsland.
*Harpa lamellifera, Tate	x		
*Harpa sulcosa, Tate, *var.*	x		Camperdown.
Zemira praecursoria, Tate	x		Camperdown.
Zemira, n. sp.			Curlewis.
Volutilithes antiscalaris, McCoy	x		Curlewis.
*Voluta hannafordi, McCoy	x		
Voluta conoidea, Tate	x		
*Voluta strophodon, McCoy	x		
*Voluta weldii, T. Woods	x		Table Cape.
Voluta ancilloides, Tate	x		
*Voluta sarissa, Tate	x		Curlewis.
*Voluta polita, Tate	x		
†Voluta cathedralis, Tate	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
†Voluta allporti, Johnston (*Syns. V. pellita, J., V. halli, Pritch.*)		x	Table Cape.
*Voluta, n. sp., *aff. V. McCoyii*			Birregurra.
*Voluta, sp., *aff. V. sarissa*			
Lyria harpularia, Tate	x		
†Mitra dictua, T. Woods	x		Table Cape.
Mitra alokiza, T. Woods	x		
†Mitra atractoides, Tate	x	x	
*Uromitra mulderi, Tate, *m.s.*			
*Uromitra leptalea, Tate	x		Moorabool.
Uromitra biornata, Tate	x		
*Uromitra exilis, Tate	x		Moorabool.
†Uromitra clathurella, Tate	x		Belmont.
*Conomitra othone, T. Woods	x	x	
Conomitra ligata, Tate	x		Mornington.
Marginella inermis, Tate	x		Table Cape; Cape Otway.
Marginella propinqua, Tate	x	x	
Marginella micula, Tate	x	x	
Marginella wentworthi, T. Woods	x	x	
†Marginella subwentworthi, Tate, *m.s.*			Belmont; Curlewis.
*Marginella globiformis, Tate	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
†Marginella woodsii, Tate	x	x	
*Marginella inequidens, Tate, *m.s.*	x		
*Fasciolaria cristata, Tate	x		Mornington.
*Fasciolaria rugata, Tate	x		Mornington.
*Fasciolaria cryptoploca, Tate	x		Gellibrand.
Fasciolaria sp.	x		Belmont.
Columbarium acanthostephes, Tate	x	x	
*Columbarium foliaceus, Tate	x		Mornington.
Columbarium craspedotus, Tate	x		Mornington.
*Fusus senticosus, Tate	x		Mornington.
*Fusus, n sp., *aff. F. hexagonalis*			
†Fusus, n. sp.			Belmont; Curlewis.
Solutofusus carinatus, Pritchard	x		
*Latirofusus aciformis, Tate	x		Mornington.
Latirofusus exilis, Tate	x		Moorabool.
Latirofusus, n. sp.			
*Latirus succinctus, T. Woods	x		Moorabool.
Latirus belmontensis, Tate, *m.s.*			Belmont.
†Latirus, n. sp., *aff. L. linteus et L. tatei*			
*Latirus, n. sp.			Mornington.
*Latirus, n, sp.			

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
*Euthria ino, T. Woods	x		Mornington.
†Euthria sp.			
*Tudicula sp.			Mornington.
†Leucozonia tumida, Tate	x		
*Leucozonia micronema, Tate			Mornington.
Siphonalia longirostris, Tate	x	x	
*Siphonalia styliformis, T. Woods	x		Curlewis.
†Siphonalia tatei, Cossmann, *var.*	x		Belmont.
†Siphonalia ischna, Tate	x		Gellibrand.
Siphonalia, n. sp.			Curlewis.
*Siphonalia, n. sp., *aff. S. styliformis*			
*Tritonofusus labrosus, Tate	x		
Cominella sp., *aff. C. fragilis*			
Phos variciferus, Tate	x		Mornington.
Nassa tatei, T. Woods	x	x	
Columbella crebricostata, T. Woods	x		Moorabool.
†Columbella, n. sp. 1, *aff. C. crebricostata*			Belmont.
*Columbella, n. sp. 2, *aff. C. crebricostata*	x		Gellibrand.
Columbella clathrata, Tate, *m.s.*	x		Curlewis.
*Columbella sp., *aff. C. clathrata*			
Columbella aciculata, Tate, *m.s.*	x		Mornington.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
*Columbella oryza, Tate, *m.s.*	x		Curlewis.
Columbella funiculata, T. Woods	x		Moorabool.
*Columbella cainozoica, T. Woods			Table Cape; *Miocene*, Muddy Creek.
*Columbella cingulata, Tate, *m.s.*	x		
*Columbella septemcostata, Tate, *m.s.*	x		
†Columbella, n. sp.			Curlewis.
†Columbella, n. sp.			
*Columbella, n. sp.			
*Murex lophoessus, Tate	x		Mornington.
*Murex camplytropis, Tate	x		Moorabool.
Murex rhysus, Tate	x		Mornington.
*Murex velificus, Tate	x	x	
Murex amblyceras, Tate	x		
*Murex asperulus, Tate	x	x	
Murex eyrei, T. Woods	x	x	
Murex polyphyllus, T. Woods	x	x	
*Murex sp., *aff. M. trochospira*			Curlewis.
*Murex, n. sp.	x		
Murex, n. sp.			
*Trophon? n. sp.			
Typhis acanthopterus, Tate			Gellibrand.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
†Typhis maccoyii, T. Woods	x	x	
†Typhis evaricosus, Tate	x		Curlewis.
Typhis laciniatus, Tate	x	x	
*Typhis disjunctus, Tate	x		Mornington.
Lampusia tortirostris, Tate	x	x	
*Lampusia tumulosa, Tate	x		
*Lampusia protensa, Tate, *var.*	x		
*Lampusia gemmulata, Tate	x		Curlewis.
*Lampusia cyphus, Tate	x		Mornington.
*Lampusia woodsii, Tate	x		Gellibrand.
*Colubraria tenuicostata, T. Woods	x		Moorabool.
Apollo prattii, T. Woods	x		Mornington.
*Morio gradata, Tate	x		Gellibrand.
*Semicassis transenna, Tate, (*non S. sufflata*, T. *Woods*)	x		Mornington.
*Cypraea contusa, McCoy	x		Mornington.
*Cypraea eximia, G. B. Sowerby	x		Gellibrand.
*Cypraea leptorhyncha, McCoy	x	x	
Cypraea pyrulata, Tate	x		
Cypraea sub-pyrulata, Tate	x		Gellibrand.
Cypraea, n. sp., *aff. C. pyrulata*			

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Cypraea, n. sp., *aff. C. brachypyga*	x		Curlewis.
Trivia avellanoides, McCoy	x	x	
*Erato morningtonensis, Tate			Mornington.
Triforis wilkinsoni, Tate	x	x	
*Triforis sulcata, T. Woods	x	x	
Triforis planulata, T. Woods	x		Gellibrand.
†Triforis sp., *aff. T. planulata*			
*Triforis sp.			Corio Bay.
*Triforis, n. sp.		x	
†Triforis, n. sp.			Belmont.
Triforis, n. sp.	x		Curlewis.
Triforis sp.	x		
*Cerithium apheles, T. Woods	x		Mornington.
*Cerithium, n. sp.			Mornington.
†Cerithium, n. sp.			Curlewis; Birregurra.
*Colina exoptata, Tate, *m.s.*	x		
*Colina nodulosa, Tate, *m.s.*	x		Gellibrand.
*Colina, n. sp.	x		Fyan's Ford.
Newtoniella cribarioides, T. Woods	x	x	
*Newtoniella eusmilia, T. Woods	x		Bairnsdale ?
*Newtoniella lineata, Tate, *m.s.*	x		Moorabool.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Newtoniella accrescens, Tate, *m.s.*	x		Curlewis.
*Newtoniella sp., *aff. N. cribarioides*			
*Newtoniella sp.			
*Newtoniella sp.			Belmont.
*Newtoniella sp.			
*Newtoniella sp.			
Newtoniella sp.	x	x	Aldinga.
*Newtoniella sp., *aff. N. quinquelirata*			
*Trichotropis subquadrata, Tate	x		Cape Otway.
*Siliquaria occlusa, T. Woods	x	x	
†Thylacodes conohelix, T. Woods		x	Gellibrand.
Turritella murrayana, Tate	x	x	Table Cape.
*Turritella acricula, Tate			*Miocene*, Muddy Creek.
Turritella tristira, Tate			Table Cape; *Miocene*, Gippsland.
*Turritella septifraga, Tate		x	
Mathilda multilirata, Tate, *m.s.*			Gellibrand.
Mathilda transenna, T. Woods	x	x	
†Mathilda, n. sp.			
Mathilda, n. sp.			Curlewis.
? Isapis, n. sp.			
†Fossarus retrofactus, Tate			Table Cape.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
*Solarium acutum, T. Woods	x		Gellibrand.
*Solarium squamogranosum, Tate, *m.s.*	x		Gellibrand.
*Solarium, n. sp.			Moorabool.
*Heliacus serratus, Tate, *m.s.*			
Rissoia varians, Tate, *m.s.*		x	*Miocene*, Muddy Creek.
†Rissoia varicifera, T. Woods			Table Cape.
*Cheilutomia subvaricosa, Tate and Coss.	x		Fyan's Ford, etc.
†Hipponyx antiquatus, Linn.	x		
*Calyptraea undulata, Tate	x		River Murray.
†Crepidula unguiformis, Lam.	x		Table Cape.
*Xenophora tatei, Cossmann	x		
Natica polita, T. Woods	x	x	
Natica hamiltonensis, T. Woods	x	x	
*Natica arata? Tate	x		
†Natica substolida, Tate	x		River Murray.
?Scalaria bulbulifera, Tate	x		
†Scalaria pleiophylla, Tate		x	Adelaide.
†Crosseia princeps, Tate	x		Adelaide.
*Eulima danae, T. Woods	x	x	
Eulima, n. sp.	x		Cape Otway.
†Eulima sp.	x		

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Eulima, n. sp.	*		*Miocene*, Muddy Creek.
*Eulima sp.			*Miocene*, Muddy Creek.
Subularia johnstoni, Tate	x	x	
Niso psila, T. Woods	x		Mornington.
†Eulimella, n. sp.			
Odontostomia victoriae, Tate, *m.s.*	x	x	
Odontostomia decurtata, Tate, *m.s.*	x		Camperdown.
*Odontostomia cingulata, Tate, *m.s.*			*Miocene*, Muddy Creek.
†Odontostomia sp.		x	
†Odontostomia sp.	x		Curlewis.
*Odontostomia sp.			
*Turbonilla cylindrica, Tate, *m.s.*	x		Moorabool.
†Turbonilla sp.			
†Pyramidella, n. sp.			
*Phasianella sp.	x		Lower Maud.
*Phasianella sp.			Moorabool.
†Collonia parvula, T. Woods	x	x	
Leptothyra sp.			
Astralium aster, T. Woods	x		Mornington.
†Astralium longispinum, Tate, *m.s.*		x	
†Cantharidus cavatus, Tate, *m.s.*	x		Gellibrand.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Cantharidus sp.			Mornington.
†Cantharidus sp.			
†Cantharidus sp.			Bairnsdale.
†Trochocochlea ? sp.			
*Gibbula echinulata, Tate, *m.s.*		x	Gellibrand.
*Gibbula sp.			
†Gibbula sp.			Mornington.
? Gibbula sp.	x		
†Eumargarita sp., *aff. E. lucens*			
Solariella strigata, T. Woods	x	x	
*Calliostoma escharoides, Tate, *m.s.*	x	x	
*Calliostoma sp.	x		
†Calliostoma sp.			
*Calliostoma sp.			Moorabool.
†Calliostoma, n. sp.			
†Liotia roblini, Johnston	x	x	
†Liotia sp.			
†Liotia sp.			
? Cyclostrema bicarinata, Tate, *m.s.*			
Tinostoma calva, Tate, *m.s.*	x	x	
*Fissurellidea malleata, Tate	x		Gellibrand.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
? Fissurellidea, n. sp.			
†Fissurellidea, n. sp.			
Emarginula cymbium, Tate *m.s.*	x		Mornington.
*Emarginula wannonensis, Harris	x		Gellibrand.
*Emarginula, n. sp., *aff. E. wannonensis*			
Emarginula, n. sp.			Table Cape.
*Subemarginula occlusa, Tate	x		Gellibrand.
*Nacella? sp.	x		
Scaphopoda.			
Dentalium mantelli, Zittel	x	x	
Dentalium subfissura, Tate	x	x	
Dentalium aratum, Tate	x	x	
*Dentalium lacteum, Deshayes	x		
†Dentalium annulatum, Tate	x	x	
Lamellibranchiata.			
*Ostrea hyotis, Linn.	x		River Murray.
*Gryphaea tarda, Hutton	x	x	
Dimya dissimilis, Tate	x	x	
Placunanomia sella, Tate	x	x	
*Spondylus pseudoradula, McCoy	x		Mornington.
Lima bassii, T. Woods	x		Mornington.

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Limatula jeffreysiana, Tate	x	x	
Limea transenna, Tate	x		Table Cape.
Pecten foulcheri, T. Woods	x	x	
Pecten sturtianus, Tate	x	x	
*Pecten murrayanus, Tate	x	x	
*Pecten consobrinus, Tate		x	Aldinga.
†Pecten polymorphoides, Zittel	x		Gellibrand.
†Pecten subbifrons, Tate			Waurn Ponds.
Amussium zitteli, Hutton	x	x	
*Amussium, n. sp.			
Pseudamussium hochstetteri, Zittel		x	River Murray.
*Septifer fenestratus, Tate	x		Moorabool.
*Philobrya bernardi, Tate, *m.s.*	x		
Crenella singularis, Tate	x	x	
Crenella globularis, Tate	x	x	
Barbatia crustata, Tate	x		Gellibrand.
†Barbatia simulans, Tate	x	x	
†Barbatia consutilis, Tate	x		Gellibrand.
Barbatia pumila, Tate	x		Gellibrand.
Plagiarca cainozoica, Tate	x	x	
Axinaea laticostata, Q. and G.	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Axinaea cainozoica, T. Woods	x	x	
Limopsis belcheri, Ads. and Reeve	x	x	
Limopsis aurita, McCoy	x		Gellibrand.
Cucullaea corioensis, McCoy	x	x	
Nucula tenisoni, Pritchard	x	x	*Miocene*, Muddy Creek.
Nucula atkinsoni, Johnston	x	x	
Nucula morundiana, Tate	x	x	
Nucula, n. sp.			Birregurra.
Nuculana vagans, Tate	x		Gellibrand.
Nuculana apiculata, Tate	x	x	
Nuculana woodsii, Tate	x	x	
Nuculana obolella, Tate	x	x	
Nuculana huttoni, T. Woods	x	x	
Nuculana embolos, Tate, *m.s.*	x	x	
†Nuculana sp., *aff. N. woodsii*			
†Nuculana, n. sp.			
Trigonia tubulifera, Tate	x	x	
Trigonia subundulata, Jenkyn	x	x	
†Cardita polynema, Tate		x	Mornington.
Cardita scabrosa, Tate	x		Lower Maud.
Cardita delicatula, Tate	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
†Cardita, n. sp.			Birregurra.
*Mytilicardita sp.			
†Carditella inornata, Tate		x	
†Carditella polita, Tate			*Miocene*, Muddy Creek.
Crassatella communis, Tate	x	x	
Protocardium hemimeris, Tate	x		Mornington.
Chama lamellifera, T. Woods	x	x	
†Montacuta, n. sp.			
†Lepton, n. sp. *aff. L. crassum*			Western Beach.
Dosinia densilineata, Pritch.		x	Table Cape.
Chione cainozoica, T. Woods	x	x	
†Chione, n. sp.	x		
Meretrix eburnea, Tate	x		Mornington.
†Mysia subquadrata, Tate	x	x	
Mysia crepidulaeformis, Tate, *m.s.*	x		Cheltenham.
†Mysia suborbicularis, Tate	x		Cheltenham; Table Cape.
†Mysia, n. sp., *aff. M. suborbicularis*			
*Mysia, n. sp.			
†Donax dixoni, Tate	x		Maud; *Miocene*, Muddy Creek.
†Hemimactra howchiniana, Tate	x	x	
Corbula ephamilla, Tate	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Corbula pyxidata, Tate	x	x	Aldinga
*Saxicava arctica, Linn.	x		Aldinga; Cape Otway.
*Capistrocardia fragilis, Tate	x		River Murray.
†Teredo haephyii, Zittel	x		River Murray.
†Lucina leucomomorpha, Tate	x	x	
Tellina stirlingi, Tate	x	x	
Semele vesiculosa, Tate	x		Gellibrand.
†Semele krauseana, Tate	x		Mornington.
†Cuspidaria, n. sp.			
†Myodora tenuilirata, Tate	x	x	
*Myodora australis, Johnston	x	x	Table Cape.
†Myodora, n. sp.			
†Verticordia rhomboidea, Tate			River Murray.
Palliobranchiata.			
*Waldheimia grandis, T. Woods			Glenelg River.
Waldheimia garibaldiana, Davidson	x		Table Cape.
†Waldheimia sp., *aff. W. tateana*			
*Terebratula vitreoides, T. Woods	x	x	
Terebratulina scoulari, Tate	x	x	
†Terebratulina catinuliformis, Tate	x	x	

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
Echinodermata.			
†Paradoxechinus novus, Laube	x	x	River Murray.
*Schizaster abductus, Tate			River Murray.
†Lovenia forbesi, T. Woods		x	Portland.
†Goniocidaris sp.			
Actinozoa.			
Flabellum distinctum, Edw. and H.		x	Cape Otway.
*Flabellum candeanum, Edw. and H.	x		Gellibrand.
Flabellum pedicellare, Tate	x	x	
Flabellum victoriae, Duncan	x	x	
Flabellum duncani, T. Woods			Table Cape.
Placotrochus deltoideus, Duncan	x	x	
Placotrochus elongatus, Duncan	x	x	
Placotrochus, n. sp.	x		Table Cape.
†Sphenotrochus sp.	x	x	
Notocyathus australis, Duncan	x	x	
†Notocyathus viola, Duncan	x	x	
Notocyathus excisus, Duncan	x	x	
†Notocyathus alatus, T. Woods		x	River Murray

List of Eocene Fossils (*Continued*).

Name of Species.	Muddy Creek.	Spring Creek.	Other Occurrences.
†Notocyathus punctatus, Tate, *m.s.*	x	x	
†Notocyathus sp.	x	x	
Notocyathus? sp.	x	x	
Conocyathus cyclostatus, T. Woods	x		Camperdown.
Trematotrochus fenestratus, T. Woods	x	x	
*Paracyathus supracostatus, Dennant			Table Cape.
†Deltocyathus italicus, Edw. and H.		x	Table Cape.
Ceratotrochus typus, Sequenza			Cape Otway.
Ceratotrochus sp. (*Smilotrochus vacuus, T. Woods*)	x	x	
†Ceratotrochus, n. sp.		x	Curlewis.
Conosmilia anomala, Duncan	x		Moorabool.
Conosmilia striata, Duncan	x	x	
Conosmilia elegans, Duncan			Gellibrand.
†Conosmilia bicycla? T. Woods	x		Curlewis.
Bathyactis lens, Duncan	x	x	
†Balanophyllia australiensis, Duncan	x	x	Cape Otway.
*Balanophyllia armata, Duncan, *var.*	x		Corio Bay.
†Balanophyllia sp., *aff. B. tubuliformis*			
†Isis sp.	x	x	
†Isis sp.			

Miocene Beds.

In August, 1896, we described a miocene outcrop near the cemetery at Shelford (Sec. IV.). We then expressed the opinion that the sediments rested upon basalt of miocene or pre-miocene age, but that they were not in turn covered by another and later lava flow. Since then, Messrs. Hall and Pritchard have announced that the miocene of the adjoining river valley, the Moorabool, is clearly overlain by basalt, and they therefore suggest that such may also be the case on the Leigh. They are quite right, and we unreservedly withdraw our previous statement to the contrary. There is, in fact, one flow of lava at a lower level than the miocene conglomerate, and also an upper and wholly distinct flow resting upon it. The section we gave is correct as far as the surface outline is concerned, but, instead of being a superficial deposit only, the miocene should be shown as passing into the hill just underneath the basalt which caps its summit. In support of our revised opinion we offer the following evidence.

A narrow gully close to the township, on the western bank of the river, shews massive blocks of the miocene conglomerate containing casts of fossils. The thickness of the deposit could not be accurately estimated, owing to the débris which covers the floor of the gully. Above the blocks, and lying right upon them, there is a jointed vesicular basalt. No mistake can be made about this section. Both rocks are undoubtedly *in situ*, and, by the weathering of the miocene boulders, the under surface of the upper basalt is for a short distance in the hill plainly disclosed. The elevation of this junction is, by aneroid, 195 feet above datum line. For about 25 feet lower down we observed ironstone blocks on the floor of the gully, when they give place to limestone, which, from the occurrence of *Schizaster abductus* in it, we consider to be eocene. The older basalt crops out still lower down at a height of 105 feet, but whether it passes under the limestone, or is only banked up against it, we were unable to determine. The base of the basalt is not visible, being concealed by surface soil.

From this gully the miocene boulders carrying fossil casts were traced uninterruptedly in a southerly direction as far as the Red Bluff, where, as we have already recorded, they are again seen to

pass under the upper basalt. Where the lower basalt exists, viz., for about three-fourths of the distance towards the Bluff, the conglomerate is always superior to it, and in some instances clearly rests upon it. The miocene, in fact, occurs in a very shallow depression or rather gentle curve on the side of the hill between the upper and lower flows.

Whether at the cemetery, and also in places along the bank, there is eocene limestone immediately beneath the conglomerate we could not definitely decide, but, judging from the two gully sections described, we think it highly probable that such is the case. The uniformly superior elevation of the ironstone boulders to the lower basalt is, however, so apparent that we made use of them both up and down the river to trace the inner or hillside outcrop of the latter rock.

To the north of Shelford, though there is abundant ironstone, we have not, so far, noticed any fossils in it. By a rigorous search fossils may perhaps yet be found there, but, even if not, the persistence of the deposit, together with its similar relations to the other rocks, sufficiently indicates its contemporaneous origin with the fossiliferous boulders lower down the river. Above a certain elevation, the blocks may become unfossiliferous simply because the tide level of the miocene sea is overpassed.

If the views here expressed are correct, it follows that considerable areas in this neighbourhood which have been hitherto classed as pliocene must be instead referred to the miocene period. Wherever ironstone occurs in the Geelong district underlying basalt of corresponding age to the upper flow on the Leigh there is, we think, presumptive evidence that it is a miocene deposit.

A catalogue of the fossils obtained from the miocene at Shelford was given in our former paper. Similar casts have been noticed in the blocks since collected. A few other species might perhaps be added by taking moulds of the casts, but as their miocene age is now generally admitted, the labour was regarded as unnecessary.

We searched the eastern bank of the river south of the bridge some time ago for miocene fossils. After breaking up a large number of ironstone boulders, we found some casts of species, identical with those previously listed, at a section (No. III.),

about half a mile lower down the river than Section IV. Its elevation is, however, the same, viz., abont 150 feet above datum line. By examining this bank at corresponding levels other outcrops of the conglomerate would no doubt be discovered.

As before stated, the upper basalt is entirely wanting on the eastern side of the river from Inverleigh right up to the escarpment opposite Dog Island. Still the two banks are of about equal height, and at first sight one is apt to think that the basalt which caps the western ridge once spread as a level sheet right across the gorge. A more correct conclusion, however, appears to be that the stream here marks a geological boundary, and that the lava, when deposited was banked up against the pre-existing tertiary strata. The junction of the igneous with the sedimentary rocks thus denotes the line of the most easily formed drainage channel, which, by continual enlargement, has finally resulted in the present wide and deep gorge of the river.

The non-existence of basalt in the strip of country enclosed by the lower courses of the Leigh River and Native Hut Creek is shown on the geological map of Victoria. Immediately the latter creek is crossed at Teesdale, basalt is again encountered, and the two streams mentioned therefore indicate the boundaries of what were probably separate lava flows, the one from the west and the other from the east.

Possibly some remnants of the lower basalt may exist on the eastern side of the river south of Shelford, but if so, they are very slight, and we judge that the miocene there rests directly upon the eocene. The latter is certainly not visible just where we record miocene fossils; but since it crops out higher up the river at the bridge section, and also lower down at Farrell's, its continuance under the ironstone right along the bank may be reasonably inferred.

It has been previously mentioned that, at the two eocene sections just quoted, the uppermost rocks consist of ironstone in boulders. We examined these, but failed to discover any signs of fossils in them. Similarly, along the upper margin of the eastern bank, as well as on the table-land back from the river, there is abundant ironstone, in which also we have not, so far, detected any organic remains. On the strength, however, of the fossil-bearing boulders in their vicinity, we class the ironstones

generally on this side of the river as miocene. Presumably, also, their continuation on the plain as far as Native Hut Creek represents a contemporaneous deposit.

A peculiar feature of the eastern bank is the presence in one or two places of masses of drift sand. The most notable of these is nearly opposite Farrell's; and when passing along the road from Shelford to Inverleigh, on the opposite side of the river, the contrast of the white sand with the surrounding green herbage on the bank is very striking. This sandy patch covers several acres, and, commencing at the top of the bank, passes down to about the level of the drift clays of Sec. I., which is not more than 100 yards distant. Amongst the sand there are quartz pebbles, occasional pieces of slate, and also a few small scattered boulders and balls of basalt. Higher up the river, and not far from Sec. III., there is at the very top of the bank a sandy mound similar to that at Farrell's, but of less extent. Here also we noticed a few very small detached boulders of basalt, together with rounded pieces of scoria, in one of which was a crystal of augite. This sand heap is probably the site of a blacks' camp, as we picked up a number of quartz chips (so-called flint knives), and also a piece of igneous rock foreign to the locality, and shaped into an axe-head. In both places, the basaltic fragments were found not on the surface of the mounds, but lying on patches of ground from which the sand had been partly removed by the wind. Judging by the intermixed fragments of slate, the sand would seem to be a drift from the upper reaches of the river when this was flowing at a higher level. If the scattered pieces of lava are also a part of the drift, they could, from their elevation, only have been derived from the upper basalt. On such a supposition, the drifts would of course be subsequent to the outpouring of the lava, and prior only to the recent alluvium on the margin of the stream.

Basalts.

In describing the sedimentary strata, we have necessarily made frequent reference to the associated basalts. Of these, there are probably several distinct flows on the river banks, some of which are undoubtedly contemporaneous or nearly so; such is, however,

not the case, for one of them, which, according to the evidence already produced, must have preceded the rest by a long interval of time. This lower or more ancient flow is well marked on the western bank from the township to within half a mile of the Red Bluff, where it terminates in a narrow tongue of land, and is seen no more. At this point it is still 110 feet above the river.

In making the main road from Shelford to Rokewood up the steep hill leading to the table-land, the basalt has been cut through, and a good section is obtained. Here it reaches to a height of 105 feet above datum line, and is apparently in sheets which incline towards the hill at an angle of 4°. We asked some workmen who were quarrying the basalt close to this section what they expected to find beneath it. They replied "limestone," and that without going to any great depth. They are undoubtedly right, but the difficulty with the lower basalt is not as to the strata which underlie it, but as to its relation to the limestone often met with at a higher level. Our experience in reference to one section will illustrate what we mean. Just below the cemetery, and at a height of 120 feet, there is a marl pit from which lime has been obtained for manuring the adjoining land. Lower down, the bank is covered with basalt, which is proved to be *in situ* by a quarry with massive rock showing. We thought at first that this basalt might pass under the limestone, the eocene character of which was determined on fossil evidence. The owner of the land obligingly sank a hole three feet deep at the base of the marl pit, making its total depth about 10 feet, which should, by the respective levels of the outcrops, have reached the supposed basalt underneath. On the contrary, he bottomed on solid massive limestone. He also gave it as his opinion that we should probably continue in the limestone by sinking lower, as he has never heard of an instance where basalt has been struck by quarrying the marls which show here and there along the bank. Higher up the river, the sections already quoted appear on the whole favourable to the view of the case here stated, viz, that the basalt is banked up against an eocene ridge instead of being an interbedded sheet. If so, it must have followed a minor depression in the older strata, and was consequently confined within narrow limits.

With regard to the relation of the lower basalt to the miocene, the evidence is conclusive. There are many sections showing the former rock with eocene strata directly underlying, but nowhere is there a trace of the miocene conglomerate in a similar position. On the contrary, it is invariably the superior rock. That it is in immediate contact with the upper eocene limestones is plainly demonstrated in several sections, but it also frequently transgresses beyond them, and then rests on the basalt. In all probability the volcanic rock was once entirely covered by the conglomerate, from which it has been in part removed by fluviatile action.

The cross section shown in the plate is intended to illustrate the *supposed* relation, on the theory just stated, of the lower volcanic to the eocene and miocene strata. If this approximately represents the disposition of the rocks below the surface, it is plain that in an eroded gully there may be limestone cropping out at a higher level than the basalt, though the latter is a subsequent deposit. The surface outline of the section is constructed from observations on the right bank of the river below Shelford.

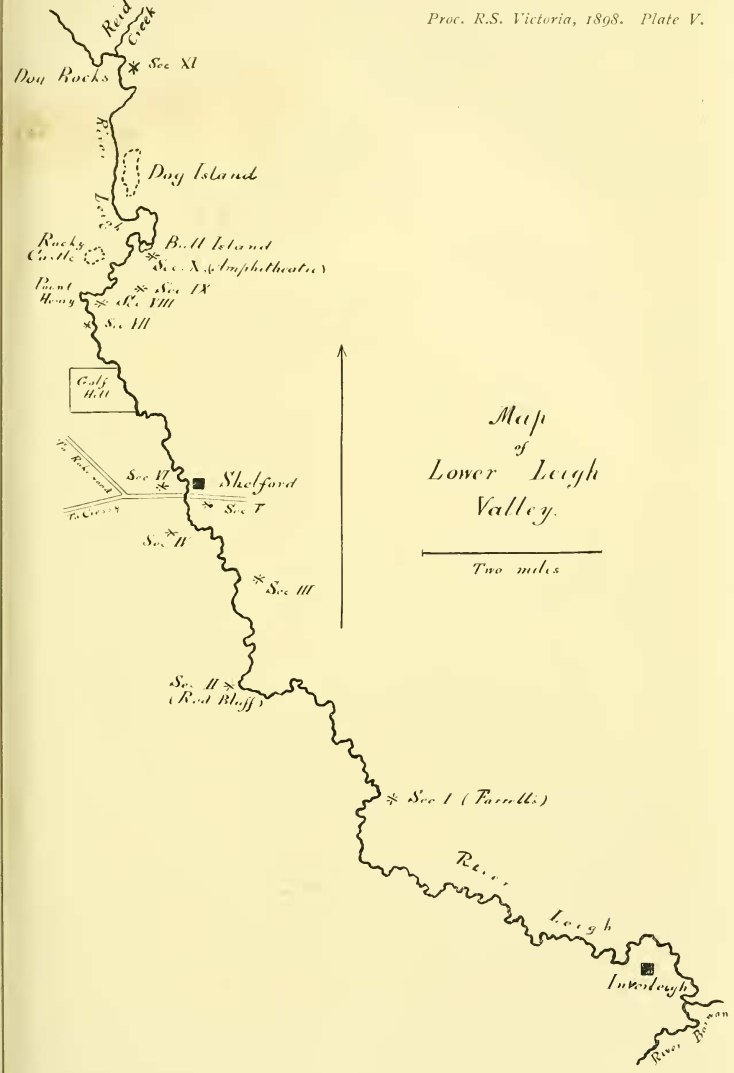
In endeavouring to trace the course of the lower basalt in the gorge of the Leigh, we will start from the north, as it has apparently flowed in a southerly direction. Only the ruins of the flow are in reality now present, a great part of it having been undoubtedly disintegrated and carried away by the action of the river. There are several prominent rocky eminences close to the bed of the river, the most notable of which is Dog Island. Another is known locally as Rocky Castle, and a third as Point Henry. Other minor knolls exist also here and there, one or two of which we have incidentally referred to before. Messrs. Etheridge and Murray, in speaking of these basaltic outliers, recognise that they mark the course of a lava flow, though the question as to whether it is distinct or not from that on the plains is left untouched. We quote their remarks in full:—"From the southern boundary of Quarter-sheet 26 S.E., down the valley of the Leigh, a series of small elevations occur in the bed of the river, of which the Dog Island is the most conspicuous. This is a small hill rising abruptly from the alluvial flat; it is capped by a layer of basalt about ten feet

thick, but at a lower level than that of the surrounding plains. Many of the small spurs jutting on to the flats from the main bank have small basaltic outliers on them, at a level about half way between the river-bed and the table-land. This basalt is evidently not interstratified with the beds of Miocene (Eocene) age; it would therefore appear that a depression in the latter had been filled in by the basalt, forming a thin capping, and that the river, in cutting its course, took the line of this depression, leaving occasional mounds and spurs from which it failed to remove all the basalt, as, from its more durable nature, it protected the beds on which it rested."

It may be added that there is a fragmentary drift, consisting of quartz pebbles from the size of a walnut downwards, on the lava of Dog Island. Below the lava eocene limestone shows in places, but only where the surface soil has been disturbed. This again rests on the ordovician. The summit of the knoll is 130 feet above the river, while the main bank is about 110 feet higher. The latter is capped by the upper basalt; just beneath this, and therefore at a high level, there are several conspicuous outcrops of massive limestone similar to those at the amphitheatre.

To trace the lower basalt continuously down the river will require some detailed plotting, which we have not yet found time for, and at present we cannot pretend to do more than give a rough outline. We have already recorded that just south of Dog Island a small outlier appears on the opposite or western bank, with only 35 feet between its base and the level of the water. Rocky Castle, which is 85 feet high, is close to this spot. Still keeping on the right bank, the old lava stream, or, to speak more correctly, that remnant of it we followed, at last strikes the river at the southern end of Henderson's Flat, where it becomes conspicuous as the bold bluff of Point Henry. From here the stream has evidently cut its way right through the lava, as this now shows on both banks. The eastern branch terminates within a short distance of Golf Hill, but the western continues on until it finally runs out about a mile and a half below Shelford.

The present thickness of the lower basalt of course varies greatly according to the amount of erosion it has suffered. At Dog Island, the Survey gives it as 10 feet; at Point Henry it is 30


Reid's Creek
Dog Rocks
Sec XI
Dog River
Dog Island
Rocky Creek
Rocky Castle
Bull Island
Sec X (Amphitheatre)
Paint Rocks
Sec IX
Sec VIII
Sec III
Gaff Hill
To Ross's road
Sec VI
Shelford
Sec I
To Creek
Sec II
Sec III
Sec II (Red Bluff)
Sec I (Falls)
River Leigh
Inverleigh
River Barwon
Map of Lower Leigh Valley.
Two miles